RTCA Special Committee 186, Working Group 5

ADS-B UAT MOPS (DO-282), Revision A

Meeting #14

Capstone Specific Addition to the UAT MOPS Requirements
A Proposal to Support the Flight Plan ID

Approved by: The White Paper Subgroup of RTCA SC-186 Working Group 5

Revision "A" was approved by Working Group 5 during Meeting #19 held 12 January 2004 and as outlined in Working Paper UAT-WP-19-02

SUMMARY

This paper presents a proposal for potential new or revised UAT MOPS text (requirements and test procedures) for adding a Flight Plan ID reporting element to the Mode Status message. This is in response to issues concerning ATC automation system requirements raised at the RTCA SC-186 plenary in June 2002.

Introduction

As stated in RTCA/Special Committee 186 (SC-186) WG-6 Issue Paper #66, which is to be considered for revisions to the ADS-B MASPS leading to DO-242B, a means is desired to communicate, via ADS-B Messages, a unique identification to correlate with a specific Flight Plan for the ADS-B system participant. Present ATC methods require the use of an assigned 12-bit code, variously referred to as a 4096-code, a Mode 3/A code, or a squawk or beacon code. For clarity, this data field will be referred to as the "Flight Plan ID".

In response to direction from the SC-186 Plenary in June 2002, this paper describes a method by which the UAT datalink can support the need, by Capstone Phase II equipment, for the Flight Plan ID while Issue Paper #66 is under consideration by WG-6 and the SC-186 Plenary.

Summary of Proposed Changes

This section presents the proposed method, and describes the specific areas of the UAT MOPS that are changed to support the proposed method.

The method proposed, is to alternate the content of the MODE STATUS Element between conveying the aircraft Call Sign, and the Flight Plan ID, at a 50% ratio. This method is only invoked upon the activation of the "Receiving ATC Services" input to the UAT equipment. When ATC services are not being received, only the Call Sign field is transmitted. This proposal requires modifications to the following sections of the UAT MOPS, as approved by SC-186 Plenary.

Item	Description of Change
Table 2-39	Define Characters 1 through 8 (which make up parts of Bytes 18 through 23) as containing the Call Sign or the Flight Plan ID.
§ 2.2.4.5.3	Throughout the body of § 2.2.4.5.3, all instances of "CALL SIGN" would be replaced with "CALL SIGN/FLIGHT PLAN ID."
§ 2.2.4.5.4.2 "CALL SIGN" Field	Modify the text to refer to Call Sign or the Flight Plan ID, define the range of values that are valid for each Character, and refer to the CSID bit to determine which coding is used. Do NOT create new subparagraph numbers.
§ 2.2.4.5.4.15 Call Sign Identification (CSID)	Define the CSID ZERO state as containing the Flight Plan ID, and allow the CSID field to alternate between the ONE and ZERO states, each time the MODE STATUS element is transmitted, when the "Receiving ATC Services" Operational Mode element is TRUE.
§ 2.4.4.5.3	Throughout the body of § 2.4.4.5.3, all instances of "CALL SIGN" would be replaced with "CALL SIGN/FLIGHT PLAN ID."
§ 2.4.4.5.4.2 Verification of "CALL SIGN" Field	Modify any steps in subparagraphs referenced in §2.4.4.5.4.2 to account for the change to "CALL SIGN/FLIGHT PLAN ID."
§ 2.4.4.5.4.15 Verification of Call Sign Identification (CSID)	Modify this test procedure to account for the change in §2.2.4.5.4.15
Table 2-64 and Table 2-98	Add a new Element #43, Flight Plan ID, as an Input Data Element, with appropriate Data Lifetime and Applicable Equipment Class information.
§ 3.6.2 Variable Data	Change the reference in the first paragraph, first line from "call sign" to "call sign/flight plan ID"

One area that does NOT require modification is § 2.2.6.1.3 “Message Transmission Cycle.” The Payload Selection-A phase that is used for the MODE STATUS element includes a transmission opportunity for each type of content on each antenna twice per 16-second epoch.

This method of supporting the Flight Plan ID has not been simulated to determine the effect on the Call Sign acquisition performance. This simulation would be used to determine the optimum ratio between transmitting the Flight Plan ID and the Call Sign. Further definition of the ADS-B MASPS requirements are required, for Call Sign acquisition and Flight Plan ID acquisition, and for both airborne and surveillance applications, before any simulation work can be usefully performed.

Because of the preliminary nature of these proposed requirements, equipment that implements the method defined in this document should also provide a means to return the equipment to a strict UAT MOPS compliant operating condition. Such a means can include, but not be limited to, the use of jumper straps or configuration parameters.

Any UAT Receiving Subsystem that is strictly UAT MOPS compliant should ignore the content of the "CALL SIGN/FLIGHT PLAN ID" field when the "Call Sign Identification" (CSID) bit of the Mode Status Element is set to the value ZERO (0).

Proposed Requirements Changes:

(1) The table that defines the Mode Status Element in the final UAT MOPS (Table 2-39) should be modified in bytes 18 through 23 as follows:

Table 2-39: Format of MODE STATUS Element

Payload Byte #	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8
.								
.								
18	(MSB)	**Emitter Category and Call Sign/Flight Plan ID Characters #1 and #2**						
19		(Base-40 encoding)						(LSB)
20	(MSB)	**Call Sign/Flight Plan ID Characters #3, #4, and #5**						
21		(Base-40 Encoding)						(LSB)
22	(MSB)	**Call Sign/Flight Plan ID Characters #6, #7, and #8**						
23		(Base 40 Encoding)						(LSB)
24	**No changes to the remainder of the existing Table**							
25								
26								
27								
28								
29								
.								
.								

(2) Throughout the body of §2.2.4.5.3, all instances of "CALL SIGN" would be replaced with "CALL SIGN/FLIGHT PLAN ID."

(3) Modify the text in §2.2.4.5.4.2 to refer to Call Sign or the Flight Plan ID, define the range of values that are valid for each Character, and refer to the CSID bit to determine which coding is used.

2.2.4.5.4.2 "CALL SIGN/FLIGHT PLAN ID" Field

The "CALL SIGN/FLIGHT PLAN ID" field consists of eight characters, which must contain only decimal digits 0-9, the capital letters A-Z, and – as trailing pad characters only – the "space" character. The 37 possible different characters are represented as Base-40 digits in the range from 0 to 36. Each character of the "CALL SIGN/FLIGHT PLAN ID" field **shall** be encoded as shown in Table 2-41. The left-most character of the "CALL SIGN/FLIGHT PLAN ID" field corresponds to Character #1; the right-most corresponds to Character #8.

The CSID field (see §2.2.4.5.4.15) identifies which type of data is contained in the "CALL SIGN/FLIGHT PLAN ID" field.

When representing the Call Sign, if the Call Sign is not available, then all eight characters of the "CALL SIGN" Field **shall** be set to the Base-40 digit code 37.

The 8 characters of the "CALL SIGN" field **shall** be encoded with an identifier appropriate for the Emitter Category, operating rules, and procedures under which the A/V is operating. For aircraft, the "Call Sign" could be an abbreviation of the authorized radiotelephone Call Sign for that aircraft as assigned by ATS, the aircraft registration marking, or other authorized identifier for special operations.

***Note 1**: A Call Sign of less than 8 characters should be padded with spaces in the right-most (trailing) positions*

When representing a Flight Plan ID, characters 1 through 4 of the Flight Plan ID **shall** be selected from the Base-40 encoding for the digits 0 through 7. Characters 5 and 6 of the Flight Plan ID **shall** be either the Base-40 digit code 37, or a digit from the range 0 through 7, as appropriate for the intended application. Characters 7 and 8 of the Flight Plan ID **shall** be set to the Base-40 digit code 37. If the Flight Plan ID is not available, then all eight characters of the field **shall** be set to the Base-40 digit code 37.

***Note 2**: This encoding of the Flight Plan ID allows for the first 4 characters to convey the 12-bit Mode 3/A code. The Mode 3/A code contains 12 bits labeled $A_4A_2A_1B_4B_2B_1C_4C_2C_1D_4D_2D_1$. When representing the Mode 3/A code in the Flight Plan ID field, the Base-40 digits are derived from the sum of the subscripts of the code pulses. Character 1 consists of the sum of code group "A" subscripts, character 2 consists of the sum of code group "B" subscripts, and so forth.*

The next two characters allow for expansion of the Mode 3/A code to 18 bits, where this may be desirable and allowed. The Mode 3/A code is assigned to the aircraft for transponder identity code reporting to ATC. When a Mode 3/A code is assigned to an aircraft, the same value should be used for the Flight Plan ID.

Note 3: The Mode Status Element always contains the Emitter Category, encoded as defined in §2.2.4.5.4.1 and Table 2-40, regardless of whether the Call Sign or the Flight Plan ID is being conveyed.

(4) Define the CSID ZERO state as containing the Flight Plan ID, and allow the CSID flag to alternate between the ONE and ZERO states, each time the MODE STATUS element is transmitted, when the "Receiving ATC Services" Operational Mode element is TRUE.

2.2.4.5.4.15 Call Sign Identification (CSID)

The Call Sign Identification (CSID) flag in the Mode Status Element (bit 7 of byte 27) is used to identify the contents of the "CALL SIGN/FLIGHT PLAN ID" field. When the "CSID" flag is set to the value ONE (1), then the "CALL SIGN/FLIGHT PLAN ID" field **shall** contain the Call Sign. When the "CSID" field is set to the value ZERO (0), the "CALL SIGN/FLIGHT PLAN ID" field **shall** contain the Flight Plan ID.

When the "Receiving ATC Services" input is FALSE, the "CSID" field **shall** always contain the value ONE (1).

While the "Receiving ATC Services" input is TRUE, the "CSID" field **shall** alternate between the TRUE and FALSE values on each subsequent transmission of an ADS-B Message containing the MODE STATUS element.

(5) Throughout the body of §2.4.4.5.3 and its subparagraphs, all instances of "CALL SIGN" would be replaced with "CALL SIGN/FLIGHT PLAN ID."

(6) Modify any steps in subparagraphs referenced in §2.4.4.5.4.2 to account for the change to "CALL SIGN/FLIGHT PLAN ID."

2.4.4.5.4.2 Verification of "CALL SIGN/FLIGHT PLAN ID" Field (§2.2.4.5.4.2)

Appropriate test procedures required to validate the requirements of §2.2.4.5.4.2 are included in §2.4.4.5.4.3.1, §2.4.4.5.4.3.2, §2.4.4.5.4.3.3, and §2.4.4.5.4.3.4.

2.4.4.5.4.3.4 Verification of Unavailable "CALL SIGN/FLIGHT PLAN ID" Field (§2.2.4.5.4.2)

Purpose/Introduction:

If the Call Sign field is not available, then all eight characters of the "CALL SIGN/FLIGHT PLAN ID" field shall be set to the Base-40 Digit code 37 ("Not Available").

Measurement Procedure:

Step 1: Call Sign – Data Lifetime

Configure the ADS-B Transmitting Equipment to transmit valid ADS-B Long Messages with Payload Type Code 1 (or Code 3 for A1H equipment class) as in §2.4.4.5.4.1. Provide the "Receiving ATC Services" Flag Input to the UUT set to FALSE. Input a "Call Sign" and a Flight Plan ID to the UUT. While the ADS-B Transmitting Equipment transmits valid ADS-B Long Messages, stop updating the "CALL SIGN" field. Set the EMITTER CATEGORY Field to the appropriate value for the intended application, per Table 2-90. Verify that after 60 seconds, all eight of the character values associated with Bytes 18 through 23 contain the Base-40 Digit value 37 ("Not Available").

Step 2: Flight Plan ID – Data Lifetime

Configure the ADS-B Transmitting Equipment to transmit valid ADS-B Long Messages with Payload Type Code 1 (or Code 3 for A1H equipment class) as in §2.4.4.5.4.1. Provide the "Receiving ATC Services" Flag Input to the UUT set to TRUE. Input a "Call Sign" and a Flight Plan ID to the UUT. While the ADS-B Transmitting Equipment transmits valid ADS-B Long Messages, stop updating the "FLIGHT PLAN ID" field. Set the EMITTER CATEGORY Field to the appropriate value for the intended application, per Table 2-90. Verify that after 60 seconds, all eight of the character values associated with Bytes 18 through 23 contain the Base-40 Digit value 37 ("Not Available") when the CSID Flag is ZERO (0).

(7) Modify the test procedure in §2.4.4.5.4.15 to account for the change in §2.2.4.5.4.15.

2.4.4.5.4.15 Verification of Call Sign Identification (§2.2.4.5.4.15)

Purpose/Introduction:

The Call Sign Identification (CSID) Flag in the Mode Status Element is a one-bit field (bit 7 of byte 27) which is used to identify the contents of the "CALL SIGN/FLIGHT PLAN ID" field. When the "CSID" flag is set to the value ONE (1), then the "CALL SIGN/FLIGHT PLAN ID" field **shall** contain the Call Sign. When the "CSID" field is set to the value ZERO (0), the "CALL SIGN/FLIGHT PLAN ID" field **shall** contain the Flight Plan ID.

When the "Receiving ATC Services" input is FALSE, the "CSID" field **shall** always contain the value ONE (1).

While the "Receiving ATC Services" input is TRUE, the "CSID" field **shall** alternate between the TRUE and FALSE values on each subsequent transmission of an ADS-B Message containing the MODE STATUS element.

Measurement Procedure:

Step 1: Call Sign Reporting Verification

Set up the ADS-B Transmitting Subsystem to transmit ADS-B Messages. Provide the "Receiving ATC Services" Flag Input to the UUT set to FALSE. Input a "Call Sign" consisting of the character sequence "ABCDEF". Input a Flight Plan ID consisting of the 4 character sequence "3562". Input an Emitter Category value of ZERO. Verify that all Transmitted Messages of Payload Type Codes of ONE (1) or THREE (3), depending upon the equipment class, contain the Call Sign Identification (CSID) Flag, bit 7 of byte 27, set to ONE (1). Verify that Call Sign/Flight ID field contains the following values:

Message Byte 18 = 0000 0001 Binary
Message Byte 19 = 1001 1011 Binary
Message Byte 20 = 0100 1101 Binary
Message Byte 21 = 0001 0110 Binary
Message Byte 22 = 0110 0011 Binary
Message Byte 23 = 1000 0100 Binary

Step 2: Flight Plan ID Reporting Verification

Set up the ADS-B Transmitting Subsystem to transmit ADS-B Messages. Provide the "Receiving ATC Services" Flag Input to the UUT set to TRUE. Input a "Call Sign" consisting of the character sequence "ABCDEF". Input a Flight Plan ID consisting of the 4 character sequence "3562". Input an Emitter Category value of ZERO. Verify that Transmitted Messages of Payload Type Codes of ONE (1)

or THREE (3), depending upon the equipment class, alternate the contents of the Call Sign Identification (CSID) Flag, bit 7 of byte 27. Verify that when transmitting Payload Type ONE (1) or THREE (3), the contents of the Call Sign/Flight ID field reflects the proper encoding for the transmitted CSID value. When CSID flag is ONE (1), verify that the contents of the Call Sign/Flight Plan ID field correspond to the values as depicted in step 1 above. When CSID flag is ZERO verify that the contents of the Call Sign/Flight Plan ID field corresponds to the following values:

Message Byte 18 = 0000 0000 Binary
Message Byte 19 = 0111 1101 Binary
Message Byte 20 = 0010 0101 Binary
Message Byte 21 = 1111 0101 Binary
Message Byte 22 = 1110 1101 Binary
Message Byte 23 = 0010 1101 Binary

Step 3: Reverting To Call Sign Reporting Verification

Reset the "Receiving ATC Services" Flag Input to the UUT to FALSE. Verify that all Transmitted Messages of Payload Type Codes of ONE (1) or THREE (3), depending upon the equipment class, contain the Call Sign Identification (CSID) Flag, bit 7 of byte 27, set to ONE (1). Verify that the contents of the Call Sign/Flight Plan ID field correspond to the values as depicted in step 1 above.

(8) Add a new Element #43, Flight Plan ID, to Table 2-64 and Table 2-98 as an Input Data Element, with appropriate Data Lifetime and Applicable Equipment Class information.

Table 2-64: UAT ADS-B Transmitter Input Requirements

Element #	Input Data Element	Relevant Paragraph	Data Lifetime (seconds)	Applicable UAT Equipment Class						
				A0, B0	A1L	A1H, B1	A2	A3	B2	B3
43	Flight Plan ID	2.2.4.5.4.2	60	M	M	M	M	M	n/a	n/a

Table 2-98: UAT ADS-B Transmitter Input Requirements

Element #	Input Data Element	Relevant Paragraph	Data Lifetime (seconds)	Applicable UAT Equipment Class						
				A0, B0	A1L	A1H, B1	A2	A3	B2	B3
43	Flight Plan ID	2.4.4.5.4.2	60	M	M	M	M	M	n/a	n/a

(9) § 3.6.2 “Variable Data” should be modified to change the reference in the first paragraph, first line from “call sign” to “call sign/flight plan ID.”

3.6.2 Variable Data

Controls used by the pilot/crew for data entry (e.g., flight number, call sign/flight plan ID, emergency status) shall correctly perform their intended functions.

The White Paper Subgroup of RTCA SC-186 Working Group 5 includes, but was not limited to:

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